



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE MECHANOTECHNICS N5

17 April 2023

This marking guideline consists of 8 pages.

QUESTION 1

1.1

$$\omega_1 = \frac{2\pi N}{60}$$

$$\hookrightarrow \frac{2\pi \times 60}{60}$$

$$\hookrightarrow 6,283 \text{ rad/s} \checkmark$$

$$\omega_2 = \frac{2\pi N}{60}$$

$$\hookrightarrow \frac{2\pi \times 1200}{60}$$

$$\hookrightarrow 125,664 \text{ rad/s}$$

$$\alpha = \frac{\omega_2 - \omega_1}{t}$$

$$\hookrightarrow \frac{125,64 - 6,283}{50}$$

$$\hookrightarrow 2,388 \text{ rad/s}^2 \checkmark$$

(8)

1.2

$$a = \alpha \times r$$

$$\hookrightarrow 2,388 \times 0,325 \checkmark$$

$$\hookrightarrow 0,776 \text{ m/s}^2 \checkmark$$

(2)

[10]**QUESTION 2**

2.1

$$m = \frac{420}{3,6} = 116,667 \text{ kg/s}$$

$$V/s = \frac{m}{\rho}$$

$$\hookrightarrow \frac{116,667}{870}$$

$$\hookrightarrow 0,134 \text{ m}^3/\text{s}$$

$$\text{No of buckets/s} = \frac{v}{s}$$

$$\hookrightarrow \frac{1,35}{0,7} = 1,929/\text{s}$$

$$V_{\text{per bucket}} = \frac{0,134}{1,929} = 0,06947 \text{ m}^3$$

(8)

$$2.2 \quad m/b = \frac{116,667}{1,929}$$

$$\hat{=} 60,481 \text{ kg/bucket} \quad (2)$$

$$2.3 \quad P_{out} = mgh$$

$$\hat{=} 116,667 \times 9,81 \times 60$$

$$\hat{=} 68\,670,196 \text{ W} \quad (2)$$

$$2.4 \quad \text{efficient} = \frac{P_{out}}{P_i}$$

$$\hat{=} \frac{68\,670,196}{90\,000} \times 100$$

$$\hat{=} 76,3\% \quad (3)$$

[15]

QUESTION 3

- 3.1
- The speed at which the haulage system moves or it is required to move
 - The surface condition of the track
 - The gradient of the track
 - The power available to haul the load
 - The strength of the rope used
 - The types of attachments used
 - The availability and reachability of the track
 - The budget available for maintenance
 - Safety concerns need to be taken into consideration
- (Any 5 × 1) (5)

3.2 3.2.1

$$\sigma = \frac{\text{strengt } h}{A_{rope}}$$

$$\sigma = \frac{\text{strengt } h}{0,31 \times D^2}$$

$$D^2 = \frac{\text{strengt } h}{0,31 \times \sigma}$$

$$D = \sqrt{\frac{720 \times 10^3}{0,31 \times 1465 \times 10^6}}$$

$$\hat{=} 0,039816 \text{ m}$$

$$\hat{=} 39,816 \text{ mm}$$

$$\text{say } D = 40 \text{ mm} \quad (5)$$

$$3.2.2 \quad M_{r/m} = \frac{d^2}{290}$$

$$5,517 \text{ kg/m}$$

(2)

$$3.2.3 \quad T_{\text{weight}} = \frac{m_1 \times g \times X \times S^2}{8 \times h}$$

$$5,517 \times 9,81 \times 5,517$$

$$40668,205 \text{ N}$$

(2)

$$3.2.4 \quad T_{\text{load}} = \frac{m_2 \times g \times s}{4 \times h}$$

$$\frac{650 \times 9,81 \times 115}{4 \times 2,2}$$

$$83329,261 \text{ N}$$

(2)

$$3.2.5 \quad f.o.s = \frac{\sigma}{T_{\text{weight}} + T_{\text{load}}}$$

$$\frac{720 \times 10^3}{40668,205 + 83329,261}$$

$$\frac{720 \times 10^3}{123997,466}$$

$$5,806$$

(4)
[20]

QUESTION 4

$$4.1 \quad T_A = 2T_p + T_s$$

$$= 2 \times 36 + 42 \checkmark$$

$$T_A = 114 \text{ teeth} \checkmark$$

(2)

4.2

Condition	Gear A	Gear P	Gear S	Arm L
Fix arm L and rotate Gear A +1 rev	+1	$\frac{T_A}{T_P} = \frac{114}{36}$ $\frac{114}{36} = 3.167$	$\frac{T_A}{T_S} = \frac{114}{-42}$ $\frac{114}{-42} = -2.714$	0
Multiply by x and add y	x + y	=16,216 kN ✓	-2,714 x + y ✓	+ y
$N_L = 45$ $N_A = 0$ $N_S = ?$	0 ✓		$N_S = ?$	45 ✓

$$N_S = -2,714x + y$$

$$y = 45 \text{ ✓}$$

$$x + y = 0$$

$$x = -y \text{ ✓}$$

$$N_L = 15 \text{ r/min ✓}$$

$$N_S = -2,714x + y$$

$$N_S = -2,714(-45) + 45$$

$$N_S = 167,13 \text{ r/min ✓}$$

(8)
[10]**QUESTION 5**

5.1

- Increases the leverage of the engine over driving shaft.
- Generates power to carry the load more effectively from rest.
- Provides medium through which the engine can be disengaged from the driving shaft.
- Provides a reverse that allows the engine to continue to run in the same direction.

(4 × 2) (8)

5.2

- Spur gear
- Helical-toothed gear
- Worm gear

(Any 2 × 1) (2)
[10]

QUESTION 6

- 6.1
- Leather
 - Rubber
 - Plastic
 - Cotton or fabric
 - Balata

(Any 4 × 1) (4)

6.2 6.2.1
$$v = \frac{\pi \times (D+t) N}{60}$$

$$= 25,863 \text{ kN}$$

$$= 41550 \text{ kg}$$

(2)

6.2.2
$$m = v \times \rho$$

$$m = w \times t \times l \times \rho$$

$$m = 1 \times 0,016 \times 1 \times 0,95 \times 10^3$$

$$= 15,2 \text{ kg/m}$$

(2)

6.2.3
$$T_C = m \times v^2$$

$$= 15,2 \times (30,729)^2$$

$$= 14352,926 \text{ N}$$

$$T_1 = w \times n \times f_t$$

$$= 1 \times 4 \times 6,5 \times 10^3$$

$$= 26 \text{ kN}$$

$$\frac{T_1 - T_C}{T_2 - T_C} = e^{\mu \theta}$$

$$\frac{26000 - 14352,926}{T_2 - 14352,926} = e^{0,3 \times \frac{165}{57,3}}$$

$$\frac{11647,074}{T_2 - 14352,926} = 2,372$$

$$2,372 T_2 = 34045,140 + 11647,074$$

$$T_2 = \frac{45692,214}{2,372}$$

$$T_2 = 19263,159 \text{ N}$$

(8)

6.2.4
$$P = (T_1 - T_2) v$$

$$= (26000 - 19263,159) 30,729$$

$$= 207016,387 \text{ W}$$

(2)

PRODUCTION AND QUALITY CONTROL N5
 $= 207,016 \text{ kW}$

6.2.5

$$\begin{aligned}
 w &= \frac{P_{total}}{P_{im}} \\
 &= \frac{65 \times 10^3}{207016,387} \\
 &= 0,031 \text{ rad/s}^2 \text{ say } w = 314 \text{ mm}
 \end{aligned}$$

(2)
[20]**QUESTION 7**

$$\begin{aligned}
 T_1 &= M_1(g+a) + F_\mu \\
 &= 1600(9,81 + 0,95) + 670 \\
 &= 17886 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 T_2 &= M_2(g-a) - F_\mu \\
 &= 850(9,81 - 0,95) - 460 \\
 &= 7071 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 T_{a1} &= (T_1 - T_2) \times r \\
 &= (17886 - 7071) \times 0,45 \\
 &= 4866,75 \text{ N.m}
 \end{aligned}$$

$$\begin{aligned}
 T_{a2} &= (I_\alpha + T_\mu) \\
 &= \left[M \times k^2 \times \frac{a}{r} \right] + T_\mu \\
 &= \left[350 \times (0,45)^2 \times \frac{0,95}{0,45} \right] + 290 \\
 &= 149,625 + 290 \\
 &= 439,625 \text{ N.m}
 \end{aligned}$$

$$\begin{aligned}
 T_{total} &= T_{a1} + T_{a2} \\
 &= 4866,75 + 439,625 \\
 &= 5306,375 \text{ N.m}
 \end{aligned}$$

[10]

QUESTION 8

$$\omega_1 = \frac{2 \cdot \pi \times 110}{60} \quad \hat{=} 11,519 \text{ rad/s}$$

$$\omega_2 = \frac{2 \cdot \pi \times 150}{60} \quad \hat{=} 15,708 \text{ rad/s}$$

$$\alpha = \frac{\omega_2 - \omega_1}{t} \hat{=} \frac{15,708 - 11,519}{40} \quad \hat{=} 0,105 \text{ rad/s}^2$$

$$T = m \cdot k^2 \times \alpha \hat{=} 1300 \times (0,82)^2 \times 0,105 \hat{=} 91,783 \text{ N} \cdot \text{m}$$

[5]**TOTAL: 100**